SALINITY TOLERANCE OF *PARATYA CURVIROSTRIS* (HELLER, 1862) (DECAPODA: ATYIDAE)

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ABSTRACT

An investigation of the salinity tolerance of the freshwater shrimp *Paratya curvirostris* (Heller, 1862) (Decapoda : Atyidae) showed that larvae survived longest at 18.8‰, a concentration assumed to be isosmotic with the blood. Adults survived at salinities up to 18‰ but survival decreased rapidly at higher concentrations.

INTRODUCTION

The salinity relationships of adults of several species of Atyidae have been studied in a variety of ways. The relationship between the osmotic concentration of the external medium and that of the blood and urine has been studied in *Paratya curvirostris* (Heller, 1862) (Decapoda : Atyidae) (Orr 1971) and *Syncaris pacifica* (Born 1968), both of which are hyperosmotic regulators. Costa (1966) studied the responses of *Caridina simoni* and *Caridina pristis* when given various choices of salinity and found that each species had a different preference. The salinity tolerances of a number of species have been investigated; *Caridina weberi* was studied by Nagabhushanum and Chinnayya (1973); *C. weberi* and *C. pristis* by Perera (1966) and *Paratya curvirostris* by Orr (1971).

The salinity relationships of larvae have been ignored except for Orr's (1971) brief report on the salinity tolerances of *Paratya curvirostris* and Garrett's (1974) very brief study of reactions to changes in salinity by the same species.

During a study of the biology of *Paratya curvirostris* (Carpenter 1976) I carried out experiments on the salinity tolerances of adults and first stage larvae from a stream in Canterbury without a well developed estuary. The results of these experiments can be compared with those of Orr (1971) who studied shrimps from a different geographical region (Auckland).

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METHODS

Adult shrimps were collected from fresh water in the Ohoka Stream (172°37'E, 43°23'S) (a tributary of the Waimakariri River, 30 km north of Christchurch) and held in fresh water in the laboratory until required.

Larvae were obtained by maintaining ovigerous females in the laboratory until the eggs hatched, and the first stage larvae were put immediately into the experimental apparatus.

All experiments were carried out at 12°C. Animals were acclimated to this temperature for two days. Fresh water and a range of salinities - 1.1, 3.8, 18.8, 31 and 35.5‰ (approximately 3, 10, 50, 80 and 100% seawater) - was used in the experiments. These salinities were prepared by filtering seawater (through Whatman No.1 filter paper) and diluting it with distilled water. The fresh water used was filtered bore water obtained from a well beneath the Zoology Department, University of Canterbury.

Quart "Agee" jars containing 800 ml of test solution were placed in a water bath and left for 12 hours to equilibrate before introducing the shrimps. Animals were transferred directly from fresh water to the test solutions; 5 adult shrimps were put into each of 8 jars at each salinity. For experiments with the larvae, thirty individuals were put in two jars of each solution. The experimental animals were not fed.

Dead adults were removed every 12 hours until all had died or 7 days had elapsed. The experiments using larvae were continued until all the larvae had died. An animal was assumed to be dead when it did not respond to touch and had begun to turn opaque (a live shrimp is almost completely transparent).

RESULTS AND DISCUSSION

The results of the experiments with adult shrimps are shown in Fig. 1. All individuals survived 168 hours (7 days) in salinities from 1.1 to 18.8‰. Survival declined rapidly at higher salinities until at 35.5‰ the animals became opaque soon after they were immersed in the test solution, indicating severe physiological stress.

Orr (1971) found that in 50% seawater (c 19‰) *P. curvirostris* ceased to osmoregulate and its blood was isosmotic with the medium. In both the Hatea and Piha Streams (near Auckland) *P. curvirostris* was found at salinities up to 20‰ (Orr 1971). This was the highest salinity at which I found shrimps in the Ashley Estuary. *Paratya australiensis* has also been found to survive in salinities up to 20‰ (Walker 1972).

The results of the experiments with first stage larvae are shown in Fig. 2. Larvae survived longest at 18‰. This result is similar to that obtained by Garrett (1974) who considered this supported Nielson's (1972) suggestion that the larva is mixohaline. However, Orr (1971) found that the osmolarity of the blood of adult *P. curvirostris*

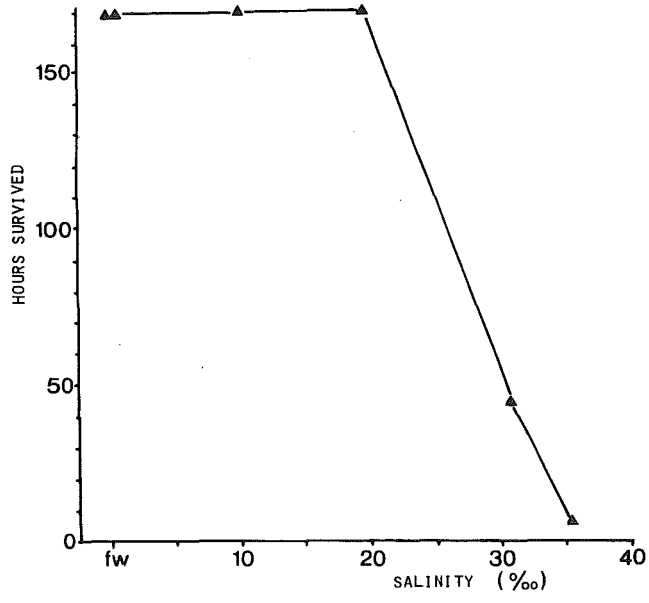

Fig. 1. Salinity tolerance of adult *Paratya curvirostris*.

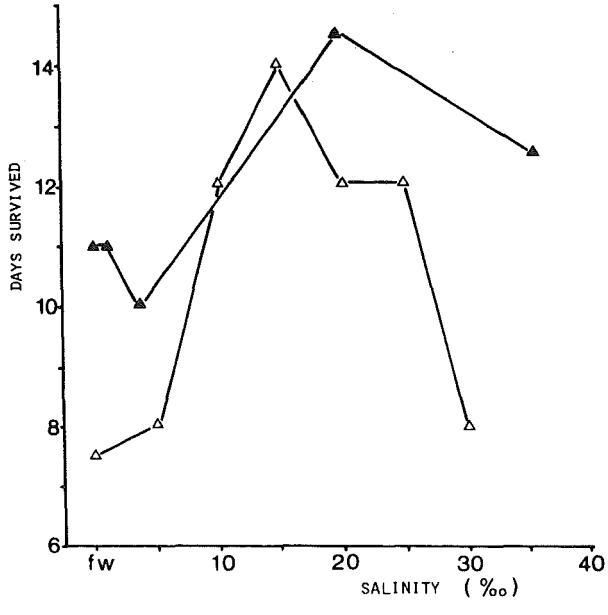

Fig. 2. Salinity tolerance of first stage larvae of *Paratya curvirostris*. Data from Garrett (1974) also shown (△——△).

was 18-20‰. If the concentration of the larval blood is similar to that of the adult, longer survival of larvae at 18.8‰ could be explained in terms of the amount of osmotic work required of an unfed larva. *Paratya curvirostris* has the smallest egg recorded for an atyid (Carpenter 1976, Glaister 1976) and consequently the yolk reserve is meagre. Hence, if the larvae are isosmotic with their medium, the limited food reserves at hatching will last longer because the amount of osmotic work required is minimal. Death of larvae in the experiments was due, possibly, to energy expenditure in osmoregulation rather than being directly due to osmotic stress. I know of no other work on the salinity tolerances of atyid larvae.

The ability of adults of both *P. curvirostris* and *P. australiensis* to live in salinities up to 20‰ may appear anomalous for a freshwater shrimp, but it is not unique for Atyidae. *Troglocaris rogersi* (Ascension Island) lives in pools with salinities as high as 40‰ (Chace and Manning 1972), whereas *Antecaridina lauensis* and *Halocaridina rubra* have been found in conditions ranging from fresh water to 25‰ (Holthius 1973). In contrast, *Caridina weberi* has not been recorded from salinities higher than 14‰ (Nagabhushanum and Chinnayya 1973), and *Syncaris pacifica* is limited to salinities below 15‰ (Born 1968).

In both *Paratya curvirostris* and *Syncaris pacifica* urine is considerably more dilute than the blood (Born 1968, Orr 1971). Such well developed osmoregulatory abilities suggest that they have evolved in association with fresh water. In both species osmoregulation ceases when the salt concentration of the medium is equal to or more than the osmolarity of the blood. This point is lower for *Syncaris pacifica* than for *Paratya curvirostris*, possibly reflecting the latter's mixohaline life history and prehistoric environment (Carpenter 1976).

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